THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An inorganic-organic hybrid (IOH) which comprises:

(i) an expandable or swellable layered inorganic component; and

(ii) an organic component including at least one ionic organic component.

2. An IOH according to claim 1, in which the organic component also includes one or more neutral organic components which are intercalated between and/or associated with the layer(s) of the inorganic component.

3. An IOH according to claim 1 or claim 2, in which the inorganic component is rendered positively or negatively charged due to isomorphic substitution of elements within the layers.

4. An IOH according to any one of claims 1 to 3, in which the inorganic component is selected from a 1:1 layered silicate structure, a 2:1 layered silicate structure, a double hydroxide of the general formula $Mg_6Al_{3.4}(OH)_{18.8}(CO_3)_{1.7}.H_2O$ and a synthetically prepared layered material.

5. An IOH according to any one of claims 1 to 4, in which the inorganic compound is a naturally occurring or a synthetic analogue of a phyllosilicate.

6. An IOH according to claim 5, in which the naturally occurring or synthetic analogue of a phyllosilicate is a smectite clay.

7. An IOH according to claim 6, in which the smectite clay is selected from montmorillonite, nontronite, beidellite, volkonskoite, hectorite,

bentonite, saponite, sauconite, magadiite, kenyaite, laponite, vermiculite, synthetic micromica and synthetic hectorite.

8. An IOH according to claim 6 or claim 7, in which the naturally occurring phyllosilicate is selected from bentonite, montmorillonite and hectorite.

9. An IOH according to any one of claims 5 to 8, in which the phyllosilicate has a platelet thickness less than about 5 nanometers and an aspect ratio greater than about 10:1.

10. An IOH according to claim 9, in which the aspect ratio is greater than about 50:1.

11. An IOH according to claim 9 or claim 10, in which the aspect ratio is greater than about 100:1.

12. An IOH according to any one of claims 1 to 11, in which the inorganic component includes interlayer or exchangeable metal cations to balance the charge.

13. An IOH according to claim 12, in which the metal cation is selected from an alkali metal and alkali earth metal.

14. An IOH according to claim 13, in which the alkali or alkali earth metal is selected from Na^+, K^+, Mg^{2+} and Ca^{2+}.

15. An IOH according to any one of claims 12 to 14, in which the cation exchange capacity of the inorganic component is less than about 400 milli-equivalents per 100 grams.

16. An IOH according to any one of claims 12 to 15, in which the ionic organic component is exchanged with the exchangeable metal ions of the inorganic component.

17. An IOH according to any one of claims 1 to 16, in which the ionic species contains onium ion(s).

18. An IOH according to claim 17, in which the ionic species containing onium ion(s) is an ammonium, phosphonium or sulfonium derivative of an aliphatic, aromatic or aryl-aliphatic amine, phosphine or sulfide.

19. An IOH according to any one of claims 2 to 18, in which the ionic or neutral organic components decompose or sublime endothermically, and/or release volatiles with low combustibility on decomposition and/or induce charring of organic species during thermal decomposition or combustion.

20. An IOH according to claim 19, in which the ionic or neutral organic component is a neutral or ionic derivative of a nitrogen based molecule.

21. An IOH according to claim 20, in which the nitrogen based molecule is a triazine based species.

22. An IOH according to claim 21, in which the triazine based species is selected from melamine, triphenyl melamine, melam (1,3,5-triazine-2,4,6-triamine-n-(4,6-diamino-1,3,5-triazine-yl)), melem ((-2,5,8-triamino-1,3,4,6,7,9,9b-heptaazaphenalene)), melon (poly{8-amino-1,3,4,6,7,9,9b-heptaazaphenalene-2,5-diyl)imino}), bis and triaziridinyltriazine, trimethylsilyltriazine, melamine cyanurate, melamine phthalate, melamine phosphate, melamine phosphite, melamine phthalimide, dimelamine phosphate, phosphazines, low molecular weight polymers with triazine and

phosphazine repeat units and isocyanuric acid and salts or derivatives thereof.

23. An IOH according to claim 22, in which isocyanuric acid and salts or derivatives thereof are selected from isocyanuric acid, cyanuric acid, triethyl cyanurate, melamine cyanurate, trigylcidylcyanurate, triallyl isocyanurate, trichloroisocyanuric acid, 1,3,5-tris(2-hydroxyethyl)triazine-2,4,6-trione, hexamethylenentetramine.melam cyanurate, melem cyanurate and melon cyanurate.

24. An IOH according to any one of claims 19 to 23, in which the organic component is a derivative of phosphoric acid or boric acid.

25. An IOH according to claim 24, in which the derivative of phosphoric acid or boric acid is selected from ammonia polyphosphate, melamine polyphosphate and melamine phosphate ammonium borate.

26. An IOH according to any one of claims 1 to 25, in which the ionic organic component is used in combination with other ionic compounds which are capable of improving compatibility and dispersion between the inorganic and organic components.

27. An IOH according to claim 26, in which the other ionic compound is an amphiphilic molecule that incorporates a hydrophilic ionic group along with hydrophobic alkyl or aromatic moieties.

28. An IOH according to any one of the preceding claims, which further comprises one or more coupling reagents.

29. An IOH according to claim 28, in which the coupling reagent is selected from an organically functionalised silane, zirconate and titanate.

30. An IOH according to claim 29, in which the silane coupling reagent is tri-alkoxy, acetoxy or halosilanes functionalised with amino, epoxy, isocyanate, hydroxyl, thiol, mercapto and/or methacryl reactive moieties or modified to incorporate functional groups based on triazine derivatives, long chain alkyl, aromatic or alkylaromatic moieties.

31. A method for the preparation of the IOH defined in any one of claims 1 to 30, which comprises mixing components (i) and (ii) defined in any one of claims 1 to 30 or constituents thereof in one or more steps.

32. A method according to claim 31, in which mixing is achieved using melt, solution or powder processing.

33. A method according to claim 31 or claim 32, in which the mixing is achieved using solution processing.

34. Use of the IOH defined in any one of claims 1 to 30 as a fire resistant material.

35. A fire resistant formulation which comprises:

(i) the IOH defined in any one of claims 1 to 30; and

(ii) one or more flame retardants.

36. A formulation according to claim 35, in which the flame retardant is selected from phosphorus derivatives, nitrogen containing derivatives, molecules containing borate functional groups, molecules containing two or more alcohol groups, molecules which

endothermically release non-combustible decomposition gases and expandable graphite.

37. A formulation according to claim 36, in which the phosphorus derivatives are selected from melamine phosphate, dimelamine phosphate, melamine polyphosphate, ammonia phosphate, ammonia polyphosphate, pentaerythritol phosphate, melamine phosphite and triphenyl phosphine.

38. A formulation according to claim 36 or claim 37, in which the nitrogen containing derivatives are selected from melamine, melamine cyanurate, melamine phthalate, melamine phthalimide, melam, melem, melon, melam cyanurate, melem cyanurate, melon cyanurate, hexamethylene tetraamine, imidazole, adenine, guanine, cytosine and thymine.

39. A formulation according to any one of claims 36 to 38, in which the molecules containing borate functional groups are selected from ammonia borate and zinc borate.

40. A formulation according to any one of claims 36 to 39, in which the molecules containing two or more alcohol groups are selected from pentaerythritol, polyethylene alcohol, polyglycols and carbohydrates.

41. A formulation according to any one of claims 36 to 40, in which the molecules which endothermically release non-combustible decomposition gases are selected from magnesium hydroxide and aluminum hydroxide.

42. A method for the preparation of the fire resistant formulation defined in any one of claims 35 to 41, which comprises mixing components (i) and (ii) as defined in any one of claims 1 to 30 or constituents thereof in one or more steps.

43. A method according to claim 42, in which mixing is achieved using melt, solution or powder processing.

44. A method according to claim 42 or claim 43, in which the mixing is achieved using melt processing in a twin screw extruder or batch mixer; or powder processing using a high shear powder mixer or milling procedures.

45. A polyamide fire resistant formulation which comprises either:

(A) (i) the IOH defined in any one of claims 1 to 30; and

(ii) a polyamide based matrix; or

(B) (i) the fire resistant formulation defined in any one of claims 35 to 41; and

(ii) a polyamide based matrix.

46. A formulation according to claim 45, in which the polyamide based matrix comprises generic groups with repeat units based on amides selected from Nylon4, Nylon6, Nylon7, Nylon 11, Nylon12, Nylon46, Nylon66, Nylon 68, Nylon610, Nylon612 and aromatic polyamides and co-polymers, blends or alloys thereof.

47. A formulation according to claim 45 or claim 46, in which the polyamide based matrix is selected from Nylon12, Nylon6 and Nylon66 and co-polymers, alloys or blends thereof.

48. A formulation according to any one of claims 45 to 47, which further comprises one or more additives.

49. A formulation according to claim 48, in which the additives are selected from polymeric stabilisers; lubricants; antioxidants; pigments, dyes or other additives to alter the materials optical properties or colour; conductive fillers or fibers; release agents; slip

55. A formulation according to any one of claims 48 to 53, in which the polyamide based matrix is present in an amount greater than about 75% w/w, the IOH is present in an amount less than about 3% w/w, the melamine cyanurate flame retardant is present in an amount of about 11 and about 15% w/w, magnesium hydroxide flame retardant present in an amount of about 1 and about 5% w/w and additives are present in an amount less than about 4% w/w.

56. A method for the preparation of the polyamide fire resistant formulation defined in any one of claims 45 to 55, which comprises dispersing the IOH as defined in any one of claims 1 to 30 or the fire resistant formulation defined in any one of claims 35 to 41 or constituents thereof into the polyamide based matrix in one or more steps.

57. A method according to claim 56, in which at least some of the components are ground prior to mixing.

58. A method according to claim 57, in which the components are ground to a particle size less than about 200 microns.

59. A method according to claim 57 or claim 58, in which dispersion is achieved using melt, solution or powder processing.

60. A method according to any one of claims 57 to 59, in which the dispersion is achieved using melt processing in a single or twin screw extruder, batch mixer or continuous compounder.

61. A method according to claim 60, in which the melt processing is conducted in a twin screw extruder.

62. A method according to any one of claims 56 to 51, in which the dispersion occurs at a sufficient shear rate, shear stress and residence time to disperse the IOH at least partially on a nanometer scale.

63. A fire resistant article or parts thereof which is composed wholly or partly of the IOH as defined in any one of claims 1 to 30 and/or fire resistant formulation defined in any one of claims 35 to 41 and claims 45 to 55.

64. A fire resistant article or parts thereof as defined in claim 63, which is used in transport, building, construction, electrical or optical applications.

65. A fire resistant article or parts thereof as defined in claim 64, in which the transport application is air, automotive, aerospace or nautical.

66. A fire resistant article or parts thereof as defined in any one of claims 63 to 65, which is a hollow article or sheet.

67. A fire resistant article or parts thereof as defined in any one of claims 63 to 66 which is selected from pipes, ducts, fabric, carpet, cables, wires, fibres, Environmental control systems, stowage bin hinge covers, cable trays, ECS duct spuds, latches, brackets, passenger surface units and thermoplastic laminate sheet.

68. A fire resistant hollow article or parts thereof which is composed wholly or partly of he fire resistant formulation defined in claim 54 or claim 55 and manufactured by rotational moulding or extrusion.

69. A fire resistant fibre, fabric, carpet or parts thereof which is composed wholly or partly of the fire

resistant formulation defined in claim 54 or claim 55 and manufactured by melt spinning or extrusion.

70. A fire resistant article or parts thereof which is composed wholly or partly of the formulation defined in claim 54 or claim 55 and manufactured by sintering.

71. A fire resistant article or parts thereof which is composed wholly or partly of the fire resistant formulation defined in claim 54 or claim 55 and manufactured by injection or compression moulding.

72. A method of preparing the fire resistant article or parts thereof defined in any one of claims 59 to 71, which comprises moulding or forming the IOH as defined in any one of claims 1 to 30 and/or the fire resistant formulation or constituents thereof as defined in any one of claims 35 to 41 and claims 45 to 51.

73. A method according to claim 72, in which the moulding or forming is carried out using extrusion, injection moulding, compression moulding, rotational moulding, blow moulding, sintering, thermoforming, calending or combinations thereof.